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A MODEL OF U.S. ARMY RECRUIT LABOR SUPPLY

by

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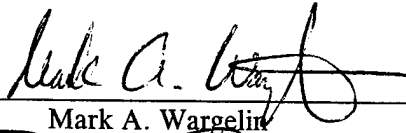B.A., The University of Akron, 1987

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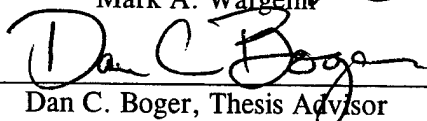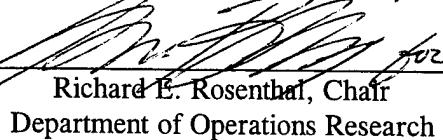
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ABSTRACT

In this thesis the author examines the military labor market and the effectiveness of the U.S. Army's enlistment bonuses and enhanced educational benefits of the Army College Fund on the recruit's labor supply decision. This paper reviews previous military manpower research and critically examines two recruit labor supply experiments -- the Multiple Option Recruiting Experiment of 1979 and the Educational Assistance Test Program of 1981. Microeconomic principles of utility maximization are used to model U.S. Army recruiter objectives and behavior as a constrained optimization of the recruiters' utility function subject to a labor supply or production possibility frontier constraint. The reduced form model is a simultaneous system of lagged equations which are estimated using a generalized least-squares technique. To evaluate the effectiveness of recruiting incentives, estimates are obtained of the elasticities of high-quality male enlistments with respect to the Army College Fund and the enlistment bonuses. The results show that these programs are successful in attracting high-quality male recruits to achieve and maintain desired force levels.

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EXECUTIVE SUMMARY

In an era of downsizing of all military forces, the United States Army faces the problem of attracting enough high-quality recruits to achieve and maintain desired force levels while the government shifts economic resources away from defense uses and towards civilian uses. In the past several years the Army has shrunk by more than 250,000 active duty soldiers from its mid-1980 level. Due to force reductions the demand for new personnel in all services has been dramatically reduced, but even amidst these changes, in 1994 the services spent approximately $1.5 billion to recruit and train new enlisted personnel. Today more than ever it is especially important that the military gets the maximum return on each dollar invested. For military manpower planners, this requires a clear understanding of the military labor market and the effectiveness of various recruiting incentives. This paper examines the Army's enlistment bonuses and the Army College Fund as recruiting incentives for high-quality soldiers.

In early 1980, the Army shifted its focus to attracting enough *high-quality* soldiers rather than enough soldiers. The Army defines a high-quality male enlistment as a young man who scores in the top half of the population on the Armed Forces Qualification Test, and who is either a high school graduate or a high school senior who will graduate. In fiscal year 1979 the U.S. Army Recruiting Command's goal was to enlist 15,000 high-quality soldiers out of a total of 120,000 recruits. By fiscal year 1982, the Army's annual high-quality goal was over 60,000 soldiers.

There are two previous generations of empirical models of military labor supply. The first generation uses simple linear models to explain the number of enlistments as a function of general measures of economic activity such as local unemployment and civilian wage rates and other variables of interest to military manpower planners. Second-generation military labor supply studies use microeconomic principles to describe recruiter goals and behavior, and to model the enlistment supply function.

This paper uses microeconomic principles of utility theory to model Army recruiter behavior and the recruit labor supply decision as a simultaneous system of equations which are estimated using a standard econometric technique of Three-Stage Least Squares regression. The data set has quarterly observations from five Army recruiting brigades for fiscal years 1988 through 1994. Estimates are made of the elasticities of high-quality male enlistments with respect to the Army College Fund and the enlistment bonuses to address the success of these programs in attracting high-quality male recruits.

The results show that current Army recruiting incentives have the desired effect. Elasticities of high-quality enlistments with respect to bonus incentives are positive and statistically significant, indicating that relatively larger bonuses attract more high-quality recruits. For advanced educational benefits such as the Army College Fund, the analysis shows that increased monetary benefits and increased availability of these benefits entice more high-quality young men to enlist.

Overall, this study suggests that enlistment bonuses and the educational benefits of the Army College Fund increase the number of high-quality male enlistments in the Army. As a recommendation to military manpower planners, recruiting incentive programs such as these are effective in attracting high-quality soldiers. Future research should focus on the cost-benefit relationship of these programs to determine how to best utilize scarce and diminishing economic resources to achieve desired force levels.

I. INTRODUCTION

A. PROBLEM DEFINITION

In an era of downsizing of all military forces, the United States Army faces the problem of attracting high-quality recruits to achieve and maintain desired force levels while the government shifts economic resources away from defense uses and towards civilian uses. At the end of this downsizing period, the active Army alone has shrunk by more than 250,000 soldiers from its mid-1980 level. Due to these shifts of resources the demand for new personnel in all services has been dramatically reduced. But even amidst these changes, in 1994 the services spent approximately $1.5 billion to recruit and train new enlisted personnel. During this period of diminishing resources it is especially important that the military get the maximum return on each dollar invested. For military manpower planners, this requires a clear understanding of the military labor market and the effectiveness of various recruiting incentives. This paper will examine the effect of the U. S. Army's enlistment bonuses and the Army College Fund on the recruit's labor supply decision.

The decade of the 1980s is noted for a tremendous improvement in the quality of enlisted personnel in all services. This is particularly true for the United States Army. While testifying before Congress in 1979, Army Chief of Staff General E.C. Meyer disclosed that he was leading a hollow Army full of soldiers of poor quality and low motivation. In an effort to revolutionize the Army's approach to recruiting,

General Meyer appointed Major General Maxwell Thurman to head the United States

Army Recruiting Command (USAREC). In early 1980, General Thurman began a

complete reorganization of USAREC which focused the Army's recruiting efforts on

attracting enough *high-quality* soldiers rather than enough soldiers.[1] In fiscal year

1979, USAREC's goal was to enlist 15,000 high-quality soldiers out of a total of

120,000 recruits. By fiscal year 1982, General Thurman had raised the Army's annual

high-quality goal to over 60,000 soldiers. This major increase in the demand for high-

quality soldiers is commonly known as the "Thurman Effect" in the literature of

military manpower.

B. BRIEF OVERVIEW OF PREVIOUS STUDIES

In broad terms, there are two previous generations of empirical models of

military labor supply. The first generation of military manpower studies, prior to

General Thurman's overhaul of USAREC, used simple linear models which regressed

the number of total enlistments, without distinctions of high-quality or low-quality

enlistments, on general measures of economic activity such as local unemployment and

civilian wage rates and other variables of interest to military manpower planners.

The second generation of military labor supply models focused on the

recruiters' institutional environment and how that environment affects the behavior of

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[1] The Army defines a high-quality male enlistment as a young man who scores in the top half of the population on the Armed Forces Qualification Test, and who is either a high school graduate or a high school senior who will graduate.

the recruiters. In 1985 Thomas V. Daula and David Smith made early attempts to model the demand side of the enlistment market. Subsequent studies by J. Kevin Berner and T. V. Daula (1993) used a constrained maximization of the recruiters' utility function subject to a labor supply or production possibility frontier constraint. Berner's approach, however, modeled recruiter behavior in three distinct situations or "regimes" which led to a burdensome switching simultaneous equation estimation.

Berner closely examines the disequilibrium nature of the market for enlistments. In this market, the quantity demanded is determined in advance of "trading" because recruiters seek recruits according to established goals or quotas. The actual number of enlistments may be more or less than the quantity demanded, so the observed trade is usually not on the demand curve. Also, because recruiters have considerable influence on the timing of the enlistment decision, Berner argues that we may not observe the supply curve, either.

C. GOAL OF THIS STUDY

This paper models the recruiters' institutional environment and the recruit labor supply decision as a simultaneous system of lagged equations which avoids the regime shifts and switching equation formulation in the Berner (1993) study. To evaluate the effectiveness of enlistment incentives I wish to obtain estimates of the elasticities of high-quality male enlistments with respect to recruiting incentives such as the Army

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College Fund and the enlistment bonuses to address the success of these programs in

attracting high-quality male recruits.[2]

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[2] Females are neglected in this study not because they are inconsequential to the Army but because historically there has been an excess supply of female recruits, allowing the Army to be very discriminating in their selection. Berner (1993) reports that females typically represent about 14% of Army enlistment contracts and comprise approximately 11% of the Army's enlisted forces.

II. BACKGROUND

This chapter defines several key terms and describes the environment of the military recruiter and the recruiting process and outlines the history of educational benefit programs available to service members. Because the model used in this study draws upon economic principles of utility theory and consumer preference, this chapter also introduces and discusses these concepts.

A. ORGANIZATION OF USAREC AND THE RECRUITING PROCESS

1. Organization of USAREC

The Army's Recruiting Command has undergone a series of changes and restructuring in the past decade. Currently USAREC is organized by recruiting brigades which geographically divide the United States into five regions. Each brigade contains a number of recruiting battalions which are subdivided into companies and stations. In response to changing demographics and military drawdown, USAREC has periodically reassigned battalions and companies within brigades and deactivated certain battalions and companies due to restructuring of recruiting goals. For the period of this study, fiscal years 1988 through 1994, USAREC was organized into five recruiting brigades with the number of recruiting battalions ranging from 54 to 56.

For the purposes of this study all enlistments are divided into high-quality and low-quality male enlistments. All recruits entering the Army must take the Armed

Services Vocational Aptitude Battery (ASVAB) series of achievement tests. A subset of the ASVAB which tests math and reading skills is called the Armed Forces Qualification Test (AFQT). AFQT test scores are placed in one of six categories which correspond to certain percentiles; Categories I, II, IIIA, IIIB, IV and V correspond to the top 10%, 25%, 50%, 75%, 90% and 100% of the U.S. population, respectively. Using this definition, Categories I-IIIA represent the top half of the U.S. population. The Army defines a high-quality enlistment as one who scores in Categories I-IIIA and who is either a high school graduate or a high school senior who will graduate.

2. Determination of Recruiting Goals

The U. S. Army uses a four-step process to set quarterly battalion high-quality goals or "missions." First, the Army's Deputy Chief of Staff for Personnel (DCSPER) sets the overall annual goal for high-quality soldiers. The annual high-quality goal is broken into quarterly goals and given to USAREC, which takes these quarterly goals and converts them into quarterly contract requirements by market segment. In the third step, USAREC forecasts the market potential for high-quality contracts for each battalion and translates the quarterly goals into monthly missions for each recruiting battalion. In the last step, the commander of USAREC talks with the individual battalion commanders and makes any necessary minor mission adjustments.

B. HISTORY OF EDUCATIONAL BENEFITS IN THE U.S. MILITARY

For the past 50 years military veterans have received federal educational assistance under various assistance programs. To date some 19 million veterans have used GI Bill or similar benefits at a total cost to the government of over $55 billion. According to Article 38 of U.S. Code 1851, educational benefits for servicemen have the following purposes:

(1) Enhance and make more attractive service in the Armed Forces of the United States, (2) extend the benefits of a higher education to qualified and deserving young persons who might not otherwise be able to afford such an education, (3) provide vocational readjustment and restore lost educational opportunities to those service men and women whose careers have been interrupted by reason of active duty...and (4) aid such persons in attaining the vocational and educational status which they might normally have aspired to and obtained had they not served their country.

Since the end of World War II and through the early years of the all-volunteer force, post-service educational benefits were perceived as a service member's right in partial compensation for compulsory service during the years of the draft. With abolishment of the draft in 1973 and establishment of an all-volunteer force, the availability of educational benefits to service members became a privilege and congressional support for government-sponsored tuition assistance programs diminished. To reduce rising costs of educational assistance, Congress passed the Veterans Education and Employment Assistant Act of 1976 which ended GI Bill eligibility for individuals entering the military after December 31, 1976, and established the Post Vietnam-Era Veterans Educational Assistance Program (VEAP). Benefits under VEAP were considerably reduced from those of the GI Bill, and service members were required to contribute to the program in order to receive benefits later.

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In the post-draft military, the role of educational benefits for service members shifted from readjustment assistance and compensation for lost educational opportunities due to mandatory military service to incentives for enlistment and retention of enlisted forces. Since its introduction in 1976, VEAP has undergone several changes in structure, contribution requirements, and available benefits. Initially VEAP provided a two-for-one matching of contributions by the service member up to a maximum contribution of $2,700 by the individual and $5,400 by the government. During his service, the individual was required to make monthly contributions of $50 to $75. Upon termination of enlistment a maximum payout of $8,100 was available.

According to many military manpower analysts, VEAP was a failure due to low participation and its inability to attract a significant number of high-quality recruits. To increase participation in VEAP and offer additional recruiting incentives, the Army College Fund (ACF) was established in 1982. The ACF provided additional monetary "kickers" for high-quality recruits who entered targeted military occupational specialties (MOS) such as Combat Arms. The amount of the kicker varied with enlistment term and skill area chosen.

To enhance the attractiveness of educational benefits for recruits, in 1985 Congress enacted the Montgomery GI Bill. Like VEAP, the Montgomery GI Bill required a contribution by the service member (a total of $1,200 during the first 12 months of service) and provided a 9-to-1 matching with a total benefit of $10,800 at the end of the service contract. After the new GI Bill took effect, the Army increased the

maximum ACF benefit to $14,400 which provided up to a maximum of $25,200 to qualified recruits for a four-year enlistment in selected MOSs.

C. MODELING PREFERENCE AND CHOICE

1. The Utility Function

According to economic theory, a consumer makes rational choices in deciding on a "consumption bundle," or what and how much to buy. To represent a consumer's wants and preferences, economists have developed an abstract mathematical function called a "utility function" which qualitatively and quantitatively describes a consumer's preference ordering when choosing different consumption bundles. There are certain mathematical requirements which must be met in order for a function to be considered a utility function. These properties, called the Axioms of Consumer Preference, govern the mathematical form of any utility function which is to be estimated.[3]

The utility function assigns a number or index to each consumption bundle which reflects the value or *utility* of that consumption bundle. A consumption bundle is denoted by the vector x, where $x = (x_1 \ x_2 \ x_3 \ ... \ x_n)$ for an n-commodity bundle. The i-th element of x, x_i, represents the amount of the i-th good consumed. The utility of bundle x is denoted by $u(x)$. If bundle x^i is preferred to bundle x^j then it follows that $u(x^i) > u(x^j)$. All bundles which are equally desirable have the same utility index. Therefore $u(x^i) = u(x^j)$ means simply that the consumer is indifferent between bundle

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[3] See Varian (1984), pp. 111-118, for a complete discussion of these axioms and their mathematical consequences.

x^i and bundle x^j. An "indifference curve" satisfies the condition $u(x) = $ constant, for all consumption bundles x.

To illustrate the utility function, consider a case where the consumer is faced with only two possible goods to purchase, say X and Y, so that his consumption bundle $x = (x,y)$. The satisfaction or utility gained by consuming x units of good X and y units of good Y, denoted by $u(x,y)$, is shown in Figure 1. Here, utility is measured vertically, and the horizontal axes measure the amount of goods X and Y consumed. The curves OA, PR, SU, and BG along the surface show how utility changes as consumption of good X increases, holding the amount of good Y consumed constant. Similarly, the curves OB, WV, and AG show how utility changes as consumption of good Y increases, holding the amount of good X consumed constant.

Figure 2 shows the same two-good utility function as in Figure 1, but here contours of equal height along the surface are drawn which represent levels of equal utility. These contours, labeled CC, DD and EE, connect points of equal altitude along the surface and are curves of constant utility. Projections of these curves downward onto the x,y-plane are the indifference curves -- these are labeled C'C', D'D', and E'E'. Along any of these indifference curves, the equation

$$u(x,y) = \text{constant}$$

is satisfied. The consumer achieves the same level of satisfaction or total utility from any consumption bundle (any combination of goods X and Y) along an indifference curve -- the consumer is indifferent between these various consumption bundles.
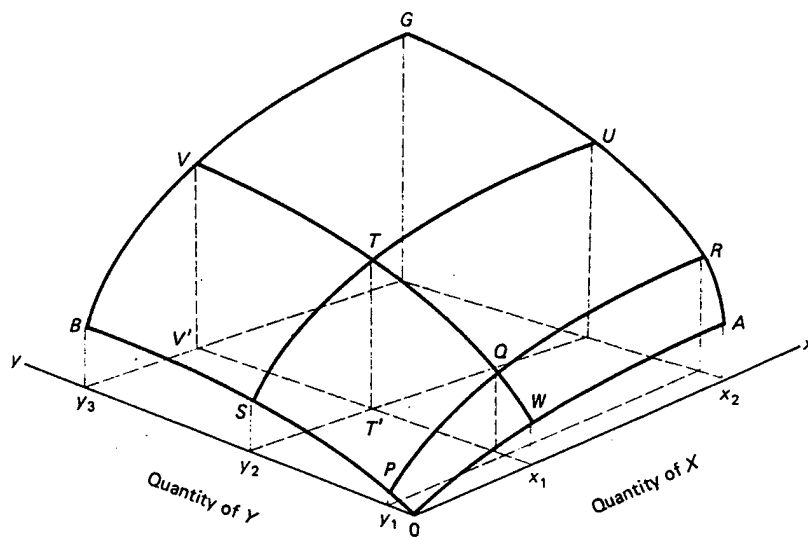
Figure 1: Total Utility Function of Two Goods
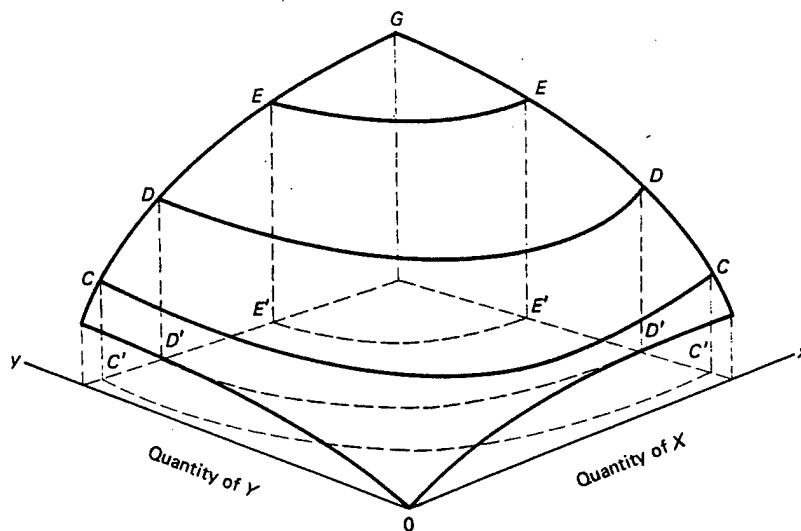
Source: Hirshleifer (1984), p. 67.

Figure 2: Total Utility Function and Indifference Curves

Source: Hirshleifer (1984), p. 67.

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2. The Budget Constraint

An obvious constraint for any consumer is his limited income or budget constraint. Continuing with the above example with only two consumption goods, X and Y with market prices P_x and P_y, respectively, the consumer's budget constraint is given by the linear equation

$$P_x x + P_y y = I$$

where I represents the consumer's fixed money income. In this simple two-commodity example, the consumer's income is completely exhausted on expenditures for goods X and Y.[4] Any combination of goods X and Y which completely exhausts the total income I is feasible. The graph of the budget constraint is simply a straight line with vertical intercept of I/P_y, which represents the number of units of good Y purchasable if the individual were to spend all his income on good Y, and horizontal intercept of I/P_x, which represents the number of units of X obtained by spending all income on good X. The slope of the budget constraint is equal to the negative of the market price ratio P_x/P_y. If one unit of good Y is given up, an amount of money P_y is made available to purchase more of good X.

3. The Constrained Optimization Problem

By combining the concept of utility curves with the budget constraint, the optimum consumption point may be determined. Economic theory predicts that the

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[4] Note that this type of analysis does not rule out the possibility of saving or investing a portion of the consumer's income. Saving can be considered a "good" whose price represents the opportunity cost of consumption goods foregone.

rational consumer chooses a consumption bundle which maximizes his utility subject to his finite budget constraint. For the simple two-commodity case with goods X and Y, the form of this constrained optimization problem is

$$\text{maximize: } U = u(x,y)$$

$$\text{subject to: } P_x x + P_y y = I.$$

This optimization problem is shown in Figure 3. The indifference curves labeled U_1, U_2, and U_3, respectively, represent increasing levels of utility. The optimum consumption point for this consumer is the point at which the budget constraint (line KL) is tangent to the highest attainable indifference curve. At point C^* the indifference curve U_2 is just tangent to the budget line KL. This bundle, containing x^* units of commodity X and y^* units of commodity Y, produces the greatest attainable level of utility given current income and market prices.

In Figure 3, points R and Q along utility curve U_1 are not optimum because a higher utility level can obtained with current income by choosing the consumption bundle at C*. Although point S along utility curve U_3 is clearly superior to C* due to its higher utility level, it is not feasible with current income and market prices.
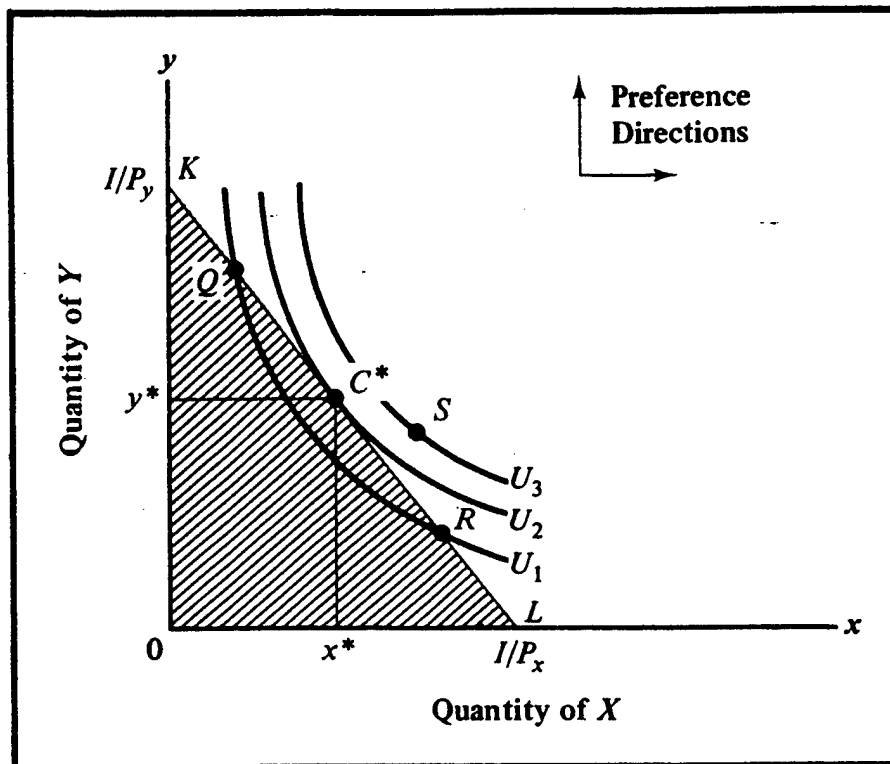
Figure 3: Optimum Consumption Point of the Consumer

Source: Hirshleifer (1984), p. 83.

III. LITERATURE REVIEW

This chapter summarizes previous military manpower studies of enlisted labor supply and identifies strengths and weaknesses of selected studies. In broad terms, there are two previous generations of military labor supply models. The earliest studies used simple regression models with little underlying economic theory to model recruit labor supply. Later research focused on applying microeconomic principles to model the recruiting process and recruiter behavior.

A. EARLY MODELS OF MILITARY LABOR SUPPLY

1. First Generation Studies

The first generation of military manpower studies used simple one-equation linear regression models which lacked any firm theoretical basis. Papers by Fisher (1969), Jehn and Shughart (1976), and Fernandez (1979) regressed the total number of enlistments, without distinctions of high-quality or low-quality enlistments, on general economic variables such as relative military-to-civilian pay and local unemployment rates. These early labor supply regression studies did little to model the demand side of the enlistment market.

2. The Multiple Option Recruiting Experiment

The Rand Corporation conducted a series of studies and experiments in the early 1980s which focused on enlistment effects of various educational assistance

programs and other recruiting incentives. One of the first studies of enhanced educational benefits was the Multiple Option Recruiting Experiment (MORE) conducted during 1979 and early 1980 and reported by Haggstrom (1981). For the Army this experiment tested various combinations of enhanced VEAP benefits, a two-year enlistment option, and a restriction that participants serve their initial tour in Europe. Each service used geographically dispersed "test cells" composed of areas served by individual Armed Forces Entrance and Examining Stations (AFEES). The Army utilized five test cells with one control cell, in which no new enlistment options were available, to test the appeal of enhanced post-service educational benefits as recruiting incentives for certain occupational specialties.

The MORE tested two levels of educational benefit enhancements in the form of "kickers," or lump sum additions to the recruit's VEAP fund. The Army initially offered a $1,000 VEAP kicker for each year of obligated service up to a maximum of $4,000 for a four-year enlistment. Later in the experiment the Army tested a "Super-VEAP plan" which offered an additional kicker of $2,000 above the standard VEAP kicker. Both plans were available only to high-quality recruits.

The Defense Manpower Data Center (DMDC) provided data for monthly enlistment contracts for each AFEES by service, sex, AFQT test score category, and education level for the period of study. Youth unemployment rate and wage level data were derived from Bureau of Labor Statistics monthly reports. The effect of the various enlistment incentives was measured by the relative increase in the number of high-quality enlistments in the test cells during the test period.

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For the Army, regression analysis revealed a 4.1% relative increase in enlistments for the two-year enlistment option, while the three- and four-year test areas produced a 7% relative increase. The combined effect of the VEAP kickers was a relative increase of 7.8% in test cells with the optional European assignment, and a 3.8% increase when the overseas assignment was mandatory. The Super VEAP kicker produced a relative increase of 2.1% above the response for the standard VEAP plan. Fernandez (1982) argues that the MORE results are plagued by too many options and too small a comparison group. Because most of the country was assigned to the kicker test cells, less than 7% of the population was left for the control group against which the success of the various VEAP kicker programs was measured.

3. The Educational Assistance Test Program

In response to the services' requests for improved incentives to attract high-quality recruits, in 1980 the House Armed Services Committee approved an amendment to the Defense Authorization Act of 1981 which authorized a test program to "encourage enlistments and reenlistments for service on active duty in the Armed Forces."[5] In 1981 the Educational Assistance Test Program (EATP) was initiated which consisted of three test programs -- an Ultra-VEAP kicker, Non-contributory VEAP, and a Tuition/Stipend. A control group of basic VEAP was used as a baseline against which the success of the test programs were measured.

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[5] Public Law 96-342, Section 901(a); and 10 U.S. Code 2141.

The EATP experiment included the Army, Navy and Air Force. Like the previous MORE experiments, each service selected random AFEES to serve as test and control cells. The EATP relied on the assumption that recruits are rational economic consumers who can compare various recruiting incentives based on discounted present values. For the Army, the test programs offered the following: (1) Ultra VEAP -- enlistment bonus kickers up to $12,000; (2) Non-contributory VEAP -- the DOD pays the enlistee's contribution, and bonus kickers up to $6,000; and (3) Tuition/Stipend -- paid tuition assistance up to $1,200 a year and a monthly $300 subsistence allowance. The Army control group was basic VEAP with kickers up to $6,000. As in the MORE tests of 1979, the EATP was open only to recruits who were high school graduates with AFQT scores in categories I-IIIA (high-quality recruits) and those entering a targeted occupational specialty.

Fernandez (1982) examined the results of the EATP by comparing the relative increase in high-quality enlistments in the test cells over the control cell areas. Control cells were assumed to account for changes in recruitment due to changing world outlook and youth attitudes towards military service.[6] For the Army, the Ultra-VEAP program resulted in the largest relative increase in high-quality enlistments. The Non-contributory VEAP had almost no effect on Army enlistments while the Tuition/Stipend option had a negative effect on high-quality recruitment.

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[6] Current military manpower analysts use the Youth Attitudes Tracking Survey (YATS) to measure the proportion of youths in a recruiting battalion area which looks favorably on service in the Armed Forces.

B. MICROECONOMIC MODELS OF MILITARY LABOR SUPPLY

1. Daula and Smith (1985)

The second generation of military labor supply models focused on the recruiters' institutional environment and how that environment affects the behavior of the recruiters. Daula and Smith (1985) closely examine enlistment goals faced by recruiters and model their effect on recruiter behavior. Daula and Smith also attempt to introduce demand into the study of the enlistment market.

Daula and Smith incorporate recruiter incentives into their model but they do not specify an equilibrium formulation. Instead they treat incentives faced by recruiters as a source of disequilibrium and propose a switching regression framework to test the hypothesis that high-quality enlistments are supply-constrained. Daula and Smith argue that recruiting battalion commanders face an asymmetric incentive structure with respect to achieving assigned high-quality quotas -- achieving the goal usually results in little or no reward, but repeated failure to achieve assigned missions may result in adverse performance reports.

2. Polich, Dertouzos, and Press (1986)

Polich, Dertouzos, and Press (1986) analyze the Army's Enlisted Bonus Experiment conducted by USAREC in 1985. They model the recruiting environment using an equilibrium specification and analyze recruiter behavior by assuming that recruiters act to maximize their utility subject to a technical constraint which reflects labor market conditions. Polich, Dertouzos and Press propose that enlistments in the Army are determined by a combination of a labor supply decision on the part of the

enlistee and enlistment production efforts of recruiters. To isolate these two effects, they suggest that there is an enlistment supply function which is a constraint on recruiter production. In other words, recruiters can enlist only willing recruits, so that the enlistment supply function operates as a production possibility frontier which constrains the total output of enlistments from USAREC.[7]

The mathematical model of the recruiting environment specified by Polich, Dertouzos and Press has a strong foundation in microeconomic theory and accurately captures the structure of the Army's recruiting environment. Its weakness is its rigid equilibrium characterization of the enlistment market.

3. Berner (1993)

In his 1993 Ph.D. dissertation, Berner builds on the work of Polich, Dertouzos, and Press and uses a constrained maximization of the recruiters' utility function subject to a labor supply or production possibility frontier constraint. Berner models recruiter behavior in three distinct situations or "regimes" which leads to a complex switching simultaneous equation estimation.[8]

Berner sets out to obtain a better understanding of the disequilibrium nature of the market for Army enlistments. Berner observes that in the enlistment market, the quantity demanded is previously determined because recruiters seek recruits according

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[7] This summary and analysis is taken from Berner (1993).

[8] Berner's three distinct regimes correspond to three typical cases that Army recruiters face each month in trying to meet monthly high-quality enlistment quotas: (1) the recruiter will come close to making quota and is therefore supply constrained, (2) the recruiter will meet his monthly goal, and (3) the recruiter has few high-quality contracts for the month and has virtually no chance of meeting his monthly goal; in this last case and in case (2), the recruiter tends to "save" any high-quality recruits for the following month's missions.

to established goals or quotas. Although the demand is perfectly inelastic, it is not

binding. The actual number of enlistments may be more or less than the quantity

demanded, so the observed trade is usually not on the demand curve. In addition,

because recruiters have considerable influence on the timing of the enlistment decision,

Berner points out that we may not observe the supply curve, either.

Berner's second objective is to endogenize the setting of the enlistment goal.

He notes that it is unsatisfactory to leave the entire demand side of the market

exogenously determined. The problem is that these two goals conflict with each other.

Berner describes the dilemma:

> Modeling the goal-setting process requires careful attention to the serial dependence of
> the jointly dependent variables. Modeling the disequilibria in the market will require
> complicated maximum likelihood estimation in which the serial dependence of the dependent
> variables will render the problem intractable. Most practitioners would agree that both
> phenomena coexist. ...focusing on only one or the other ignores the basic problem of the
> recruiting battalion commander: How to string together several successful months of
> recruiting, knowing that consistently high achievement will cause goals to increase.[9]

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[9] Berner (1993), p. 11.

IV. MODEL DEVELOPMENT

A. DETERMINATION OF THE STRUCTURAL FORM

To model recruiter behavior and the recruit labor decision process, I draw upon

the microeconomic principle of utility theory. I propose that recruiters' welfare or

utility depends on the number of enlistments, the quotas for enlistments, and the effort

expended. This relationship can be written as

$$U = U(E, H, L, Q_H, Q_L)$$

where E represents an index for recruiter effort, H is the number of high-quality

recruits, L is the number of low-quality recruits, Q_H is the quota for high-quality

recruits, and Q_L is the quota for low-quality recruits. Because recruiting battalion

commanders are evaluated on the basis of the number of enlistments relative to quotas

for each category, it follows that utility is positively related to H and L, and inversely

related to Q_H and Q_L. For a given level of achievement, recruiters' utility is inversely

related to the amount of effort expended.[10]

Recruiters are constrained in maximizing their objectives by a limited labor

supply. The supply of high- and low-quality recruits depends on economic variables

such as the local civilian wage and unemployment rates, and recruiting resource

expenditures such as advertising and bonus incentives to attract potential enlistees. In

other words, recruiters act to maximize their utility subject to an enlistment supply

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[10] This parallels the conceptual framework presented in Polich, Dertouzos, and Press (1986).

function that reflects labor market conditions. I propose a constrained optimization of the recruiters' utility function of the form

$$\text{Max}_{E,H,L} \{E^{\delta_1} + (H/Q_H)^{\delta_2} + (L/Q_L)^{\delta_3}\} \qquad (1)$$

$$\text{s.t. } \ln(H) = \lambda \ln(L) + X\beta + \ln(E)$$

where H and L are the number of high- and low-quality recruits, respectively, E is an index of recruiters' effort, Q_H and Q_L are the recruiters' goals or quotas for high- and low-quality enlistment contracts, respectively, and X is a matrix of exogenous supply factors which include the unemployment rate, the civilian wage rate, the number of recruiters in a given area, previous high- and low-quality quotas, and dollar expenditures on local and national advertising. The vector β represents the coefficients of the regressors in the supply factor matrix X.

The constraint in equation (1) is an enlistment supply function, or a production possibility frontier, which contains several policy variables under USAREC control as well as exogenous environmental variables. The tradeoff parameter λ is expected to be negative and represents a measure of the opportunity cost of a low-quality recruit in terms of high-quality recruits.

The maximand in equation (1) is an individual recruiter's utility function which preserves the microeconomic principles previously discussed. Given the incentives which he or she faces, a recruiter's utility increases with more recruits of either type, while higher quotas or goals reduce a recruiter's utility. Expending greater effort to

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achieve the same output would reduce the recruiter's utility which suggests that $\delta_1 < 0$.

USAREC's emphasis on recruiting high-quality personnel implies that $\delta_2 > \delta_3$. To

ensure appropriate marginal utilities, both δ_2 and δ_3 must lie between zero and unity.

Therefore, the structural model in equation (1) captures the most prominent features of

the recruiting environment: recruiter performance is measured relative to assigned

goals; the Army values high-quality recruits more than low-quality enlistments; and

low-quality enlistment contracts are not substitutes for high-quality contracts.[11]

B. DETERMINATION OF THE REDUCED FORM

1. Removing Unobservable Variables

The index of recruiter effort, E, is unobservable but the construction of the

utility function permits its elimination by solving for effort in terms of the other

observable variables. After solving for effort in terms of the other variables and then

substituting for effort in the first-order conditions of the constrained maximization, we

obtain the following system of equations: [12]

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[11] Low-quality contracts play an important role in the scheduling and operation of recruit training and indoctrination centers. The Army desires a constant flow of recruits through its training centers. Because high-quality enlistments tend to peak in the fourth quarter of the fiscal year (following high school graduation), low-quality contracts are used to smooth the flow of recruits through recruit training centers. The low-quality quotas are therefore varied countercyclically with respect to high-quality accessions.

[12] The transformation of the structural model into the reduced form estimating equations is lengthy and beyond the scope of this thesis. Because my structural form is similar to that used in Berner (1993), the motivated reader is referred to pages 15 through 26 of his paper for the mathematical details of this transformation.

$$\ln(H) = \alpha \ln(L) + X_1\beta_1 + \gamma_{11} \ln(Q_H) + \varepsilon_1 \qquad (2)$$

$$\ln(L) = X_2\beta_2 + \gamma_{21} \ln(Q_H) + \gamma_{22} \ln(Q_L) + \varepsilon_2 \qquad (3)$$

where H, L, Q_H, and Q_L have the same meaning as before. The regressor matrix **X** has been partitioned into submatrices X_1 and X_2 of labor supply and policy covariates which best explain the supply of high- and low-quality enlistments. From the preceding theoretical assumptions about the signs and relative magnitudes of the δ_i parameters in the structural model, it follows that $\alpha < 0$ and $\gamma_{ij} > 0$ for all i,j.[13]

Equations (2) and (3) adequately explain the market for high- and low-quality enlistments if the recruiters' quotas are exogenously determined. Brown (1986) warns, however, that exogenous recruiter goals are unrealistic. Moreover, Berner (1993) found significant evidence to endogenize the high-quality enlistment quotas faced by US Army recruiters. [14]

2. Modeling the High-Quality Quota

As previously noted, Berner (1993) attempted to endogenize the setting of the enlistment quotas for high-quality recruits. Berner and Daula (1993) made a similar

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[13] Recall that recruiter behavior and economic theory predicted $\lambda < 0$, $\delta_1 < 0$, and $0 < \delta_3 < \delta_2 < 1$.

[14] Several early studies of military manpower completely ignored the effect of missions or goals assigned to recruiters; see, for example, Fernandez (1979), Ash, Udis and McNown (1983). Other studies treated these missions as strictly exogenous to the recruiting process; see Dertouzos (1985) and Daula and Smith (1986).

attempt.[15]   As discussed in Chapter II, the Army uses a four-step process to set

quarterly high-quality goals in which USAREC forecasts the market potential for high-

quality contracts for each battalion and translates the quarterly goals into monthly

missions for each recruiting battalion.

To describe the goal setting process for high-quality enlistments, I propose a

simplified model of high-quality contracts with variables which capture the effects of

education and bonus incentives. The model for determining the high-quality contract

goal is

$$\ln(Q_H) = X_3\,\beta_3 + \varepsilon_3 \tag{4}$$

where X_3 contains one-quarter lagged values of appropriate regressors from equations

(2) and (3) and additional bonus and education incentive variables.

Consistent estimation of the parameters in equations (2) through (4) is the focus

of this thesis. These equations form a simultaneous system. Unless $cov(\varepsilon_1,\varepsilon_3) =$

$cov(\varepsilon_2,\varepsilon_3) = 0$, the high-quality quota Q_H of equation (4) will be correlated with the

error terms in equations (2) and (3), and it must be considered endogenous. By testing

this covariance condition, an assessment of previous studies which have treated Q_H

exogenously can be made.

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[15] The reader may question why Berner and Daula did not also treat the low-quality goal as endogenous.
They argue that during the 1980s, the Army's emphasis on recruiting more high-quality males caused it to
treat the number of low-quality contracts as a slack variable. As a result, the low-quality goal was not
assigned to battalions on the basis of market potential. They also argue that endogenizing the low-quality
goal would greatly complicate the estimation with little potential for improving the results.

C. ESTIMATION OF THE REDUCED FORM MODEL

1. Characteristics of the Reduced Form

The reduced form model in equations (2) - (4) is reproduced below. For convenience the three equations of the system are hereafter referred to as the High-quality equation, the Low-quality equation, and the High-goal equation, respectively.

$$\text{High-quality:} \quad \ln(H) = \alpha \ln(L) + X_1\beta_1 + \gamma_{11} \ln(Q_H) + \varepsilon_1 \qquad (2)$$

$$\text{Low-quality:} \quad \ln(L) = X_2\beta_2 + \gamma_{21} \ln(Q_H) + \gamma_{22} \ln(Q_L) + \varepsilon_2 \qquad (3)$$

$$\text{High-goal:} \quad \ln(Q_H) = X_3\beta_3 + \varepsilon_3 \qquad (4)$$

This is an interdependent system of linear equations. The regressor matrices X_1, X_2, and X_3 contain lagged values of the dependent variables. One dependent variable, the high-quality quota Q_H, appears as an explanatory variable in two equations. Ordinary least squares (OLS) estimation of these equations produces parameter estimates which are biased and inconsistent.[16]

There are several alternative estimation techniques available for simultaneous equation systems. Single-equation estimation procedures such as indirect least squares (ILS), instrumental variable (IV) estimation, and two-stage least squares (2SLS)

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[16] To be more precise, the presence of endogenous variables on the right-hand side of a simultaneous equation model guarantees that OLS estimates of the structural form parameters will be inconsistent. However, OLS estimates of the reduced form parameters will be consistent, since only predetermined variables appear on the right-hand side of the reduced form equations. The problem of obtaining unique structural parameters from the set of reduced form parameters is the identification problem. See Greene (1993), chapter 20.

produce estimates which are consistent but, in general, not asymptotically efficient.

The parameter estimates are asymptotically inefficient because not all of the

information available in the system is used. More inefficiency arises because single-

equation estimation does not account for the likely correlation of the error terms across

equations.[17] As discussed in Kmenta (1971), if we disregard the correlation between

the disturbances of different structural equations, we do not use all the available

information about each equation, and, therefore, do not attain asymptotic efficiency.

This deficiency can be overcome, however, by estimating all equations of the system

simultaneously.

2. Simultaneous System Methods of Estimation

"System methods" of estimating simultaneous-equation systems yield smaller

variance (more efficient) estimates than do single-equation methods. There are two

principle full-information methods -- three-stage least squares (3SLS) and full-

information maximum likelihood (FIML) -- which yield unbiased estimators with

greater asymptotic efficiency than those attainable by limited-information methods.[18]

The main disadvantage to all systems estimation techniques, however, is that parameter

estimates are very sensitive to the model specification. As Pindyck (1981) notes, a

serious specification error in one equation can affect the estimated parameters in *all*

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[17] See Pindyck and Rubinfeld (1981), section 11.4.

[18] For additional details of 3SLS and FIML estimation, see Johnston (1984) pp. 486-492, and Greene (1993) pp. 610-615.

equations of the model system. Thus, the gain in efficiency of a systems estimation technique comes at the risk of serious consequences of a model specification error.

Three-stage least squares (3SLS) is an extension of the Zellner estimation technique for seemingly-unrelated equation models where a series of equations are linked because the error terms across equations are correlated.[19] 3SLS is based on the application of generalized least-squares estimation to a system of equations, each of which has first been estimated using 2SLS techniques. In the first stage of the 3SLS process, the reduced form of the model is estimated. In the second stage, the fitted values of the endogenous variables are then used to obtain 2SLS estimates of all equations in the simultaneous system, and the residuals of each equation are used to estimate the cross-equation variances and covariances. In the third and final stage of this process, generalized least-squares parameter estimates are obtained.[20] Madansky (1964) proves that the 3SLS procedure produces more efficient parameter estimates than 2SLS because it takes into account cross-equation correlation.[21]

The reduced form model described in equations (2) - (4) was estimated by 3SLS using the SAS/ETS statistical software system.[22] The data used in the estimation process are discussed in Chapter V. The results and analysis of the results are discussed in Chapter VI.

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[19] See Zellner (1962), pp. 348-368.

[20] See Zellner and Theil (1962), pp. 54-78.

[21] See Madansky (1964), pp. 55-57.

[22] Specifically, the SAS procedure SYSLIN with option 3SLS was used to do the estimation. See SAS/ETS User's Guide, Version 5 Edition, SAS Institute Inc., Cary, NC.

V. DATA

A. PERIOD OF STUDY

This study uses a panel data set with Army recruiting brigades as the cross-sectional unit and with quarterly observations from October 1987 to September 1994. During this time period, USAREC underwent a period of change and reorganization in which some recruiting battalions were deactivated and others were reassigned to different brigades. Between fiscal year 1988 through 1994, USAREC was organized into five recruiting brigades and contained between 54 and 56 recruiting battalions. During these changes, however, accurate records of goals, accessions and other relevant data were not kept or have since been lost.[23] In an attempt to alleviate this data availability problem and to reduce the size of the data set, the battalion observations were aggregated to the brigade level. The resulting panel data set has quarterly observations on 5 recruiting brigades for fiscal years 1988 through 1994.

B. VARIABLES DEFINED

The reduced form model in equations (2) - (4) attempts to model recruiter behavior and the recruit labor supply function based on exogenous supply factors which include the unemployment rate, the civilian wage rate, the number of production recruiters in a brigade, previous high- and low-quality quotas, and dollar expenditures

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[23] Numerous phone conversations with personnel at USAREC have failed to produce the needed data broken down by recruiting battalions.

on local and national advertising. The following is a brief description of the variables used in the analysis.

1. High- and Low-quality Enlistments (HIGH, LOW)

The dependent variable in the high-quality (low-quality) equation is the log of number of male high-quality (low-quality) enlistments in a given recruiting brigade in a given quarter. The Army defines a high-quality recruit as someone who scores in the top half of the youth population on the Armed Forces Qualification Test and has at least a high school diploma, or is a high school senior who will graduate. All enlistments who are not high quality are considered low quality.

2. High- and Low-quality Quotas (QH, QL)

The dependent variable in the high-quality goal equation is the log of the quarterly goal for high-quality enlistments in a given recruiting brigade in a given quarter. The low-quality goal is a slack variable which is implicitly determined by a "flow balance" equation of Army endstrength: authorized endstrength minus high-quality goal plus current stock of soldiers.

3. Delayed Entry Program losses (DEPloss)

High-quality recruits are permitted to delay entry into the Army after they sign an enlistment contract under the Delayed Entry Program. Sometimes individuals change their minds or become ineligible for service and do not fulfill their obligation; this is called a DEPloss. Because DEPlosses offset current enlistment contracts on a one-for-one basis, an increase in DEPlosses in any period should make recruiters work harder, resulting in more high-quality enlistments in that period.

4. Relative Military-to-Civilian Wage (RELPAY)

Berner (1993) carefully developed a civilian alternative wage series for 17-21 year old males whose primary activity is other than being a student.[24] Berner's resulting wage series was used in calculating the relative military-to-civilian pay. Military pay consists of four components: Base Pay, Basic Allowance for Quarters, Basic Allowance for Subsistence, and a tax factor which accounts for the tax-exempt status of BAQ and BAS. We expect that, *ceteris paribus*, the higher military pay is relative to civilian pay, the greater the number of high-quality enlistments.

5. Unemployment (UNEMP)

This is the adult unemployment rate in each geographical recruiting brigade area. USAREC calculates monthly regional unemployment rates from Bureau of Labor Statistics data to produce a series with cross-sectional (by recruiting battalion) and monthly time series variation. For this study, USAREC's unemployment series was aggregated by brigade and quarter. We expect that, *ceteris paribus*, higher levels of regional unemployment will be associated with higher levels of enlistments.

6. Recruiters (RECR)

This is the number of production recruiters assigned to the recruiting brigade who are actually involved with recruiting (this excludes those assigned to

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[24] Most previous studies of military labor supply have used the Manufacturing Wage Series available from the Bureau of Labor Statistics as their measure of alternative (civilian) employment opportunities. Berner argues that this wage series, which gives average earnings for workers in the manufacturing sector, greatly overstates the compensation that a 17-21 year old male is likely to receive when looking for his first job. Berner's constructed wage series has both cross-sectional (by recruiting battalion) and monthly time series variation.

administrative duties.) We expect that, *ceteris paribus*, more recruiters in a brigade will produce more enlistments.

7. Qualified Military Available (QMA)

This is an estimate of the number of 17-21 year old males (both high- and low-quality) in the recruiting brigade area who are eligible for military service. USAREC produces a monthly QMA series compiled by battalion. For this study, the series was aggregated by recruiting brigade and quarter.

8. Youth Attitudes (YATS)

The Youth Attitudes Tracking Survey is a telephonic survey conducted by the Defense Manpower Data Center (DMDC) which attempts to measure the proportion of young men who look favorably upon service in the Armed Forces. USAREC "crosswalks" (cross-tabulates) the raw data from DMDC to produce a series which has both cross-sectional and monthly time series variation. For this study, the series was aggregated by brigade and quarter.

9. Advertising (ADV)

The ideal series would measure the advertising impressions available through various media in each recruiting area, but such a series of advertising impressions does not exist. As a proxy to this, dollar expenditures on national Army advertising (in print and electronic media) is used.[25] This series has no cross-sectional variation and only annual time series variation.

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[25] Previous studies have used a variety of measures of advertising impressions. Berner (1993) uses both National Advertising and Local Advertising expenditure variables in his model. I chose not to separately address local advertising because each recruiting battalion commander is given a fixed annual budget for

10. Enlistment Bonus (AVBON and BONCOV)[26]

The AVBON variable is a measure of the average enlistment bonus amount (measured in 1990 dollars) available to qualified individuals who agree to serve in certain occupational specialties. The bonus coverage series, BONCOV, measures the fraction of recruits who are eligible to receive an enlistment bonus. USAREC provides these series monthly for all recruiting battalions. For this study, the series was aggregated by brigade and quarter. It is reasonable to expect larger bonus amounts will attract more high-quality recruits, and as more enlistees become eligible to receive enlistment bonuses, more will be enticed to enlist.

11. Educational Benefits (ACF and ACFCOV)[27]

The ACF variable measures the present value (in 1990 dollars) of all educational benefits available over the period of this study. The educational benefits coverage variable (ACFCOV) measures the average fraction of high-quality recruits who were eligible for the Army College Fund kickers, and is part of an Eligibility for Educational Benefit series maintained by USAREC. Other things being equal, we

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local advertising, and in general, that entire budget is spent. Moreover, there is little variation in the annual advertising budget assigned to individual battalions.

[26] An enlistment bonus is available to qualified recruits who agree to serve in certain specialties, such as combat arms, which are traditionally difficult to fill. USAREC maintains that the principal purpose of the enlistment bonus is to channel high-quality soldiers into positions which will benefit the most from these individuals, and to increase the length of these enlistments.

[27] Several educational benefit programs were available during the period of this study, including versions of the Veteran's Educational Assistance Program (VEAP) and the Montgomery GI Bill. Under VEAP, any enlistee could contribute up to $2700 to an educational fund, and the government matched those contributions two-to-one. In 1981, the Army proposed an expanded educational benefits program which added up to $12,000 (a "kicker") for high-quality recruits in certain occupational specialties. In fiscal year 1982 this program was adopted as the Army College Fund. See Fernandez (1982) for details.

expect increased benefits should result in more high- and low-quality enlistments, and

increased eligibility for ACF should mean more high-quality enlistments.

VI. ANALYSIS AND RESULTS

A. REDUCED FORM MODEL

The reduced form model in equations (2) - (4) is reproduced here with variable names defined in the previous section. All data were centered to remove recruiting brigade-specific effects and transformed by taking the natural log. With the specific variable names inserted, the High-quality equation, the Low-quality equation, and the High-goal equations are:

$$\text{HIGH} = a_0 + a_1\text{LOW} + a_2\text{QH} + a_3\text{RELPAY} + a_4\text{UNEMP} + a_5\text{AVBON} + a_6\text{BONCOV}$$
$$+ a_7\text{ACF} + a_8\text{ACFCOV} + a_9\text{ADV} + a_{10}\text{RECR} + a_{11}\text{QMA} + a_{12}\text{HIGH}_{-1} + \varepsilon_1$$

$$\text{LOW} = b_0 + b_1\text{QL} + b_2\text{QH} + b3\ \text{RELPAY} + b_4\text{UNEMP} + b_5\text{AVBON} + b_6\text{BONCOV}$$
$$+ b_7\text{ACF} + b_8\text{ACFCOV} + b_9\text{ADV} + b_{10}\text{RECR} + b_{11}\text{QMA} + b_{12}\text{LOW}_{-1} + \varepsilon_2 \quad .$$

$$\text{QH} = c_0 + c_1\text{BONCOV} + c_2\text{ACFCOV} + c_3\text{ADV} + c_4\text{DEPloss} + c_5\text{YATS} + c_6\text{QH}_{-1} + \varepsilon_3$$

B. INTERPRETATION OF RESULTS

Table 1 contains the parameter estimates and associated standard errors for the above three equations estimated using 3SLS. Because the primary goal of this study is to examine the effectiveness of the Army's enlistment bonus and educational benefits programs in attracting high-quality recruits, emphasis is placed on the estimated parameters for the High-quality equation. For the overall model, however, most of the explanatory variables have estimated coefficients with significant t-statistics at the 5%

significance level. With the a priori assumption that my model specification is correct, this implies that the chosen regressors do well in explaining variation in the endogenous variables for the collected data set. Although my proposed model is based on economic principles and makes practical sense, it is unlikely that my model perfectly describes the recruit labor supply decision and the US Army recruiting process. Nonetheless, several observations may be made to address the impact of enlistment bonuses and enhanced educational benefits on potential high-quality recruits.

For the High-quality equation, the four explanatory variables of most interest are the AVBON, BONCOV, ACF, and ACFCOV variables. The coefficient of AVBON measures the impact of average enlistment bonus amounts. For my proposed model the estimated coefficient is positive and statistically significant, indicating that relatively larger bonuses attract more high-quality recruits.[28]

The Bonus Coverage (BONCOV) variable, which measures the average fraction of recruits who are eligible to receive bonuses, has a statistically significant *negative* estimated coefficient in the High-quality equation. This result is troubling since we expect that as more recruits become eligible to receive bonuses, more young men will be enticed to enlist. This anomalous result suggests that my model may be misspecified.

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[28] The corresponding coefficient for the Low-quality equation, however, is negative and significant at the 5% level; this implies that relatively larger bonuses tend to reduce the number of low-quality enlistments. Because most enlistment bonus programs are tailored to attract high-quality recruits to certain skill areas, this result is not entirely unreasonable.

The Educational Benefits (ACF) variable measures the present value of all educational benefits available to recruits. For the High-quality equation it has a positive and statistically significant estimated coefficient. As postulated, increased educational benefits tend to attract more high-quality young men. The corresponding coefficient on the Low-quality equation is negative but insignificant at the 5% level.

The Educational Benefits Coverage (ACFCOV) variable, which measures the average fraction of high-quality recruits who are eligible for the ACF incentives or "kickers," has a positive and significant coefficient for both the High- and Low-quality equations. This result agrees with our expectations that increased eligibility for ACF benefits will attract more high-quality recruits. The positive (and significant) coefficient on the Low-quality equation is puzzling since the ACF is primarily intended for only high-quality enlistees. Perhaps this enlistment incentive has a "spillover effect" in that low-quality recruits (AFQT categories IIIB,IV, and V) hope to become eligible for the ACF and are persuaded to join the Army.

Table 1: Parameter Estimates for Reduced Form Model

(Standard Errors are given in parentheses)

Explanatory Variable	High-quality Equation	High-goal Equation	Low-quality Equation
Log of Low-quality Enlistments (LOW)	-0.820 (0.236) *	n/a	n/a
Log of High-quality Goal (QH)	0.412 (0.0377) *	n/a	0.525 (0.068) *
Log of Low-quality Goal (QL)	n/a	n/a	0.272 (0.031) *
Log of Relative Military to Civilian Pay (RELPAY)	0.226 (0.0931) *	n/a	-0.232 (0.0485) *
Log of Local Adult Unemployment Rate (UNEMP)	0.287 (0.0243) *	n/a	0.392 (0.0370) *
Log of Average Enlistment Bonus Amount (AVBON)	1.052 (0.509) *	n/a	-0.234 (0.108) *
Average Fraction of Recruits Eligible for Bonus (BONCOV)	-2.17 (0.334) *	1.32 (0.128) *	0.386 (0.295)
Log of Present Value of Educational Benefits (ACF)	0.536 (0.125) *	n/a	-0.087 (0.0760)
Avg Fraction of Recruits Eligible for Educational Benefits (ACFCOV)	0.268 (0.0359) *	0.613 (0.013) *	0.281 (0.0601) *
Log of National Advertising Expenditures (ADV)	0.277 (0.0518) *	-0.334 (0.086) *	0.482 (0.367)
Log of the Number of Production Recruiters (RECR)	0.054 (0.0851)	n/a	1.22 (0.495) *
Log of Qualified Military Available (QMA)	1.48 (0.370) *	n/a	0.427 (0.240)
Log of Number of Delayed Entry Program Losses (DEPloss)	n/a	3.12 (0.307) *	n/a
Proportion of Youths Who Look Favorably on Military (YATS)	n/a	-0.709 (0.431)	n/a
Log of High-quality Goal Lagged 1 Quarter (QH $_{-1}$)	n/a	3.43 (0.442) *	n/a
Number of High-quality Enlistments Lagged 1 Quarter (HIGH $_{-1}$)	3.56 (0.0176) *	n/a	n/a
Number of Low-quality Enlistments Lagged 1 Quarter (LOW $_{-1}$)	n/a	n/a	0.535 (0.190) *

* Indicates significance at the 5% level for H_o: $\beta_i = 0$ vs. H_a: $\beta_i \neq 0$.

Table 2 contains the overall measures of fit for the estimated model. The SAS/ETS 3SLS model fit output includes information on model and error sum of squares. As shown by the calculated F-statistic for the overall simultaneous system fit, when compared to the tabled F-statistic value $F(3,28;0.05) = 2.95$, the model significantly explains the variation in the endogenous variables. Both the R^2 and Adjusted-R^2 values are good for an empirical model estimated using a large panel data set.

Table 2: Measures of Fit for Estimated Model

Model Sum of Squares	135.2231
Error Sum of Squares	31.5984
Model Mean Squares (MSR)	45.0744
Error Mean Squares (MSE)	0.9875
F-Value = MSR/MSE	45.647
Root MSE	0.9937
R-squared	0.8106
Adjusted R-squared	0.7923

VII. CONCLUSIONS AND RECOMMENDATIONS

This study has attempted to model the demand side of the enlistment market by using a simultaneous equation model of recruiter behavior and incentives and recruit labor decision making. It follows the same theoretical approach as two previous military manpower studies but greatly simplifies their switching regression formulation by use of a system of lagged simultaneous equations. With the ultimate goal of evaluating the effectiveness of enhanced educational and monetary recruiting incentives, an enlistment supply function for high-quality recruits is estimated.

Estimated elasticities of high-quality enlistments with respect to the Army College Fund reveal that increased educational benefits tend to attract more high-quality young men. This enlistment incentive may also display a "spillover effect" in that low-quality enlistees who hope to become eligible for the ACF are persuaded to join the Army as well.

Elasticities of high-quality enlistments with respect to bonus incentives are positive and statistically significant, indicating that relatively larger bonuses attract more high-quality recruits. Analysis reveals that relatively larger bonuses tend to reduce the number of low-quality enlistments, possibly because most enlistment bonus programs are tailored to attract only high-quality recruits to specific occupational skill areas.

These results suggest that enlistment bonuses and the Army College Fund increase the number of high-quality male enlistments in the Army. As a recommendation to military manpower planners, programs such as these are beneficial in attracting and maintaining high-quality soldiers. Future research should focus on the cost-benefit relationship of these programs to determine how to best utilize scarce and diminishing economic resources to achieve desired force strength.

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